Educational Outcomes of I-BEST, Washington State Community and Technical College System's Integrated Basic Education and Skills Training Program: Findings from a Multivariate Analysis

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Executive Summary

Nationally, relatively few of the more than 2.5 million adults who enroll annually in basic skills programs advance successfully to college-level coursework. This limits the ability of such individuals to secure jobs that pay family-supporting wages and that offer opportunity for career advancement. This paper presents findings from a study conducted by the Community College Research Center (CCRC) at Teachers College, Columbia University, on the outcomes of the Integrated Basic Education and Skills Training program, or I-BEST, an innovative program developed by the community and technical colleges in Washington State to increase the rate at which adult basic skills students enter and succeed in postsecondary occupational education and training.

Under the I-BEST model, basic skills instructors and college-level career-technical faculty jointly design and teach college-level occupational courses for adult basic skills students. Instruction in basic skills is thereby integrated with instruction in college-level career-technical skills. The I-BEST model challenges the conventional notion that basic skills instruction ought to be completed by students prior to starting college-level courses. The approach thus offers the potential to accelerate the transition of adult basic skills students to college programs.

The CCRC study reported on here used multivariate analysis to compare the educational outcomes over a two-year tracking period of I-BEST students with those of other basic skills students, including students who comprise a particularly apt comparison group — those non-I-BEST basic skills students who nonetheless enrolled in at least one workforce course in academic year 2006-07, the period of enrollment in the study. The researchers examined data on more than 31,000 basic skills students in Washington State, including nearly 900 I-BEST participants. The analyses controlled for observed differences in background characteristics of students in the sample.

The study found that students participating in I-BEST achieved better educational outcomes than did other basic skills students, including those who enrolled in at least one non-I-BEST workforce course. I-BEST students were more likely than others to:

- Continue into credit-bearing coursework;
- Earn credits that count toward a college credential;

- Earn occupational certificates; and
- Make point gains on basic skills tests.

On all the outcomes examined, I-BEST students did moderately or substantially better than non-I-BEST basic skills students in general. The I-BEST group's comparative advantage relative to non-I-BEST basic skills students who enrolled in at least one workforce course was not as large, but was still significant.

The study also compared I-BEST students to a group of non-participants with similar characteristics who were matched with the I-BEST students using a statistical technique called propensity score matching (PSM). Using the PSM analysis, the study estimated that, over the two-year tracking period, the probability that I-BEST students would earn at least one college credit was 90 percent, while the probability for the matched students was 67 percent, a 23 percentage point difference. I-BEST students earned, on average, an estimated 52 quarter-term college credits, compared to an average of 34 quarter-term credits for the matched comparison group. I-BEST students had a higher probability of persisting into the second year: 78 percent, compared with 61 percent for the matched group. The chances of earning an occupational certificate was 55 percent for I-BEST students, compared with only 15 percent for the matched group. I-BEST students also had a higher likelihood of making point gains on the CASAS basic skills test: 62 percent compared with 45 percent for the matched group.

While the results of this analysis show that participation in I-BEST is correlated with better educational outcomes over the two-year tracking period, it is important to note that they do not provide definitive evidence that the I-BEST program *caused* the superior outcomes. It could be that, because of the way students are selected into the program, those who participate have higher motivation or other characteristics not measured in this study that make them more likely to succeed. Selection bias could also operate in the other direction if I-BEST students are more disadvantaged in ways we do not measure.

In the future, CCRC researchers plan to conduct fieldwork to better understand the process by which students are selected into the program. CCRC will also extend this study by examining degree attainment and labor force outcomes of I-BEST students over a longer timeframe, by collecting financial data to estimate program cost-effectiveness, and by examining the practices of I-BEST programs that produce superior outcomes.

1. Introduction and Background

Today, most jobs that pay wages sufficient to support a family require at least some postsecondary education, and, increasingly, a college credential (Barton, 2000; Baum & Ma, 2007; Osterman, 2008). Yet, according to the Census Bureau (2007a), more than 75 million Americans 25 years and older have no education beyond high school. More than 30 million of them lack a high school credential or GED. In addition, over 12 million individuals in this age group lack basic fluency in English (U.S. Census Bureau, 2007b), which also limits the ability to secure a good job.

Community colleges, schools, and community organizations offer programs for adults with limited skills and education, including adult basic education (ABE) and GED preparation programs for individuals who do not have a high school credential, and English-as-a-second-language (ESL) programs for those with limited proficiency in English. Over 2.5 million students enroll each year in adult basic skills programs funded by states and the federal government (U.S. Department of Education, 2006). Yet, few students in these programs advance to college-level education and training, even if they are enrolled in a program offered at a community college.

For example, a study conducted in Washington State (Prince & Jenkins, 2005), where ABE and ESL programs are delivered through community and technical colleges, found that only 31 percent of a cohort of students who started in ABE earned at least one college credit in five years. The comparable rate for students who started in ESL was only 12 percent. This same study found that, compared with students who earned fewer than 10 college credits, those who reached the "tipping point" of earning at least two semesters of credits and a credential had a substantial average annual earnings advantage: $7,000 for students who started in ESL, $8,500 for those who started in ABE or GED, and $2,700 and $1,700 for those who entered with at most a GED or high school diploma, respectively.

One reason that few students in adult basic skills programs advance successfully to college-level coursework is that such programs are typically not well aligned with college-level offerings. Adult basic skills students often do not have access to counselors and other supports available to students in college programs. Moreover, many students in

adult basic skills programs face the challenge of having to balance school and family while working one or more low-wage jobs.

The study reported on here, conducted by the Community College Research Center (CCRC) at Teachers College, Columbia University, examined the outcomes of an innovative approach to increasing the rate at which adult basic skills students enter and succeed in postsecondary education and training. The model, known as Integrated Basic Education and Skills Training, or I-BEST, was developed by the Washington State community and technical colleges, based on the conviction that helping the state's growing number of poorly educated immigrants and other low-skill adults succeed in postsecondary training connected to jobs of importance to local economies had become an economic imperative (Bloomer, 2008; WSBCTC, 2005). In the I-BEST model, basic skills instructors and college-level career-technical faculty jointly design and teach college-level occupational (or what the Washington community and technical colleges call "workforce") courses for adult basic skills students.[1] Under I-BEST, instruction in basic skills is combined with instruction in college-level career-technical skills. Students receive college credit for the workforce portion of the program (though not for the basic skills instruction).

The program design was motivated by research suggesting that teaching basic skills in the context of materials that are of interest to the student — sometimes called "contextual instruction" — can improve learning of basic skills by adults (Resnick, 1987; Shore, Shore, & Boggs, 2004; Sticht, 1997; Stone, Alfred, Pearson, Lewis, & Jensen, 2005; Weinbaum & Rogers, 1995). In I-BEST, basic skills instruction is typically customized to the given workforce program. For example, for students enrolled in a nursing program, there may be increased emphasis on learning medical terms in addition to mastering everyday vocabulary used in all fields. If a student is having difficulty understanding technical material because of problems with English, the basic skills instructor is there to help. The theory is that student motivation and achievement will increase because students are able to immediately experience the usefulness of their basic skills education in the learning of technical skills and knowledge.

[1] Both instructors of a course are required to be present in class for at least half of the total instructional time.

Integrating the teaching of basic skills and college-level career-technical skills, as is done through the I-BEST model, challenges the conventional notion that basic skills instruction should be completed prior to starting college-level courses. The approach thus offers the potential to accelerate the rate at which basic skills students advance to college programs. Preliminary analyses of I-BEST program outcomes by researchers at the Washington State Board for Community and Technical Colleges (WSBCTC) found that participating students were substantially more likely than non-participating adult basic skills students to advance to college-level workforce programs and to reach the "tipping point" of having earned at least one year of credits and a credential (WSBCTC, 2005, 2008).

Based on these promising early results, the WSBCTC approved increased funding of programs using the I-BEST model. I-BEST courses receive 75 percent more funds per full-time-equivalent student than do regular basic skills courses. With this enhanced funding, the program model has expanded from pilots at 5 colleges in 2004-05 to programs at all 34 community and technical colleges in the Washington State system. Over 115 I-BEST programs are currently offered in such fields as nurse assistant, early childhood education, and business technology (Bloomer, 2008). Table 1 shows the fields in which I-BEST students enrolled in 2006-07. The WSBCTC requires that credits earned in I-BEST programs, which are typically a single quarter term in length,[2] should apply to certificate or degree programs that are part of a "career pathway," that is, programs that clearly connect to further education and career-path employment in the given field.

[2] The Washington community and technical colleges operate on a quarter system.

Table 1. I-BEST Enrollments by Program Description, 2006-07[3]

Program Description	Enrollment
Data Entry/Microcomputer Applications (General)	172
Early Childhood Education and Teaching	92
Nurse/Nursing Assistant/Aide and Patient Care Assistant	74
Automobile/Automotive Mechanics Technology/Technician	73
Welding Technology/Welder	71
Medical/Clinical Assistant	71
Criminal Justice/Law Enforcement Administration	54
Home Health Aide/Home Attendant	42
Nursing/Registered Nurse (RN, ASN, BSN, MSN)	20
Medical Office Management/Administration	18
Truck and Bus Driver/Commercial Vehicle Operation	17
Medical Reception/Receptionist	17
Occupational Safety and Health Technology/Technician	15
Office Management and Supervision	15
Accounting Technology/Technician and Bookkeeping	13
Business/Office Automation/Technology/Data Entry	12
Electrical, Electronic and Communications Engineering Technology/Technician	11
Medical Administrative/Executive Assistant and Medical Secretary	5
Graphic and Printing Equipment Operator, General Production	4
Manufacturing Technology/Technician	4
Natural Resources Law Enforcement and Protective Services	4
Forensic Science and Technology	2
Executive Assistant/Executive Secretary	2
Business Administration and Management, General	1

[3] Due to limitations in the administrative data, 87 of the 896 I-BEST students enrolled in 2006-07 were lacking information on which vocational program they were enrolled in; this table thus reflects the program enrollments of 809 I-BEST participants.

The early analyses of I-BEST programs by the WSBCTC were descriptive in nature, in that they did not control for student characteristics that could bear on outcomes. In addition, those analyses did not consider that the way students are selected into programs may influence the results. According to program administrators, I-BEST students most often find out about I-BEST through word of mouth or by participating in a non-I-BEST basic skills course (either ABE or ESL). Students are also referred by persons affiliated with a given college, such as counselors, as well as by outside entities. Organizations that have referred students to I-BEST include WorkSource, which is Washington State's system of public "one-stop" employment centers, WorkFirst, Washington State's program for connecting public aid recipients to jobs, and various retraining programs for dislocated workers. Finally, students may also apply directly to I-BEST programs, which are publicized through such means as college websites, catalogs, and flyers.

Students are therefore selected into I-BEST in a non-random manner. WSBCTC staff members have indicated that the program may be better suited to individuals with higher basic skills proficiencies. The program may also attract students who are more motivated than others with similar backgrounds and preparation for success in their education or career. To accurately estimate the effect of I-BEST on student outcomes, what is ideally needed is a comparison group of non-I-BEST students who are similar to the students who enroll in I-BEST in all relevant dimensions other than their enrollment in the program.

For this study, we chose as the main comparison group those basic skills students who, on their own accord, also took at least one (non-I-BEST) college-level career-technical course. We refer to this group as Non-IB Workforce students. This is a small subset of all basic skills students in the Washington State community and technical college system. Of the comparison groups that we have ready access to in terms of available data, this is the one most closely comparable to the I-BEST students because they, like the I-BEST students, were exposed to both basic skills instruction and workforce classes during the period under study. We know, however, that student selection into this comparison group operated differently than in the I-BEST group, most obviously because the two groups differ on observed characteristics, and, secondly,

because they likely differ on characteristics that we do not observe. It is important to keep in mind these caveats regarding sample selection when considering our results.

This study used multivariate analysis to compare the educational outcomes of I-BEST students with those of other students with similar characteristics. Our analysis addressed two main questions:

1) What are the socioeconomic, demographic, and enrollment characteristics of I-BEST students compared with other basic skills students?
2) How do the educational outcomes of I-BEST students compare with those of other basic skills students and, in particular, with those in the group mentioned above — students who take at least one workforce course but who are not involved in I-BEST?

2. Data and Methods

The data used in this study were drawn from administrative data shared with the Community College Research Center (CCRC) by the WSBCTC on both I-BEST and non-I-BEST students who enrolled at any college in Washington State's community and technical college system at any time during the academic year 2006-07. We chose to study students who enrolled in 2006-07 because WSBCTC staff indicated that this was the first year that the program moved beyond the pilot phase and was in full operation. We restricted our study to those students who took a non-credit adult basic skills course (including, of course, the I-BEST students themselves) in that academic year. We did not include the many students who were enrolled in programs designed to prepare for transfer to baccalaureate programs because I-BEST programs exist only in occupational fields. We also restricted our study to students in the 24 colleges that offered I-BEST in 2006-07 (the program was expanded to all 34 colleges the following year). We studied data on 31,078 students, of whom 896 were I-BEST students. Of the remainder, 28,826 were students who enrolled only in basic skills courses, and 1,356 were basic skills students who also enrolled in at least one (non-I-BEST) workforce course.

The dataset contains information on the socioeconomic and demographic characteristics of each student in the sample, as well as transcript data, which we used to determine the number of credits completed and credentials earned. The transcript data enabled us to track students through the end of the academic year 2007-08 and back to the earliest date each student enrolled in the system, making it possible to control for any credits earned prior to 2006-07.

The study was designed to examine the effects of participation in I-BEST on the following educational outcomes over two years:

- Whether a student earned any college credits;
- The total number of college credits earned;
- The number of college vocational credits earned;
- Whether the student persisted into the following academic year;
- Whether the student earned a certificate or associate degree; and
- Whether the student achieved gains on basic skills tests.

For each of these outcomes, we produced descriptive statistics comparing I-BEST students with two groups: 1) all basic skills students not in I-BEST ("Non-I-BEST students") and 2) those basic skills students not in I-BEST who took at least one workforce course during 2006-07 ("Non-IB Workforce students"). Note that we also make reference to basic skills students not in I-BEST who *did not* enroll in a workforce course ("Non-IB Non-Workforce students").

We then performed regressions to compare: a) I-BEST students and Non-IB Non-Workforce students, b) Non-IB Workforce students and Non-IB Non-Workforce students, and c) I-BEST students and Non-IB Workforce students. We used linear regression or logistic regression, depending on the outcome. In each case, we controlled for student characteristics and enrollment patterns that might bear on the outcomes. For the logistic outcomes, we measured differences in the probability of the given outcome between each pair of groups. For the continuous outcomes, we measured the differences in the outcome itself.

Finally, we compared the outcomes of I-BEST students with those of Non-I-BEST basic skills students who were matched to the I-BEST students using propensity score matching (PSM). See the appendix for a brief description of this method. We used both regression analysis and PSM to see how similar the results from the two methods would be and thus make as an informal test of the robustness of our findings, although the two methods cannot be directly compared and draw on different groups of students. For reasons described in the appendix, we give more credence to the estimates of treatment effects produced by PSM than to the results of the regressions. Neither regression analysis nor PSM allows us to correct for selection bias that might be caused by characteristics we do not observe or measure, however. This remains a limitation of this study.

We consider the treatment in this study to be *enrollment* in I-BEST, rather than *completion* of an I-BEST program, because we want to view any program attrition effects as part of the program itself; that is, we want in our estimates of program effects to account for how successful I-BEST was at retaining students. Nevertheless, we have been informed by WSBCTC staff that I-BEST programs have high retention and completion rates.

In all of the tables presented here, we report only the main effects and omit the effects for the controls. We used the same set of controls for all of the regressions and in our propensity score models. The means for all of the control variables are listed in Table 4, which is discussed in the next section.

3. Findings

We start by giving descriptive statistics on the I-BEST students, the Non-IB Non-Workforce students, and the Non-IB Workforce students in our sample. We then present results of the multivariate analyses for each outcome.

3.1 Descriptive characteristics and outcomes

Overall, 896 I-BEST students were enrolled at 24 community or technical colleges in Washington State in academic year 2006-07 (see Table 2). In this study, all Non-I-BEST students as well as all those who did enroll in I-BEST programs were, by definition, enrolled in basic skills coursework. Of the 30,182 Non-I-BEST students in the sample, 1,356 also took a workforce course. Thus, like the I-BEST students, the latter enrolled in both basic skills and workforce coursework in 2006-07. However, unlike the I-BEST students, they did not necessarily take the coursework concurrently, and they did not take it as part of an integrated program designed to accelerate the transition from basic skills to college-level workforce programs. These Non-IB Workforce students comprise the group that we believe is most comparable to the I-BEST group.

Table 2. Distribution of Basic Skills Students, 2006-07

Program Type	Enrollment
I-BEST	896
Non-IB Non-Workforce	28,826
Non-IB Workforce	1,356
Total	31,078

Table 3 shows that I-BEST students were much more likely than Non-I-BEST students to advance to college-level coursework and to earn many more college and vocational credits. This result is descriptive in nature and does not control for differences among students in these groups. I-BEST students were also more likely than Non-IB Workforce students to advance and to earn more college and vocational credits. Again, this result is descriptive.

As Table 3 indicates, over the course of the two-year observation period, I-BEST students completed slightly more than an academic year's worth of college coursework, on average, while Non-I-BEST students earned very few credits. Of these students, the Non-IB Workforce subset accumulated many more credits, on average, than the rest of the Non-I-BEST students, but not as many as the I-BEST students. Table 3 also shows that 54 percent of I-BEST students earned a certificate or degree, as opposed to less than one percent of all Non-I-BEST students and 18 percent of Non-IB Workforce students. Virtually all awards earned by anyone in these groups were occupational certificates, not degrees.

Table 3. Educational Outcomes of Basic Skills Students over Two Academic Years, 2006-07 and 2007-08

Student type	Earned any college credit	Mean number of college credits	Earned any vocational credit	Mean number of vocational credits	Earned a certificate	Earned an associate degree	Earned a certificate or associate degree
I-BEST	90.0%	48.7	87.8%	41.5	54.1%	0.2%	54.2%
All Non-I-BEST	7.0%	2.3	5.3%	1.4	0.8%	0.0%	0.8%
Non-IB Workforce	64.2%	35.7	59.6%	24.8	17.8%	0.2%	18.0%

Table 4 lists the background characteristics that were used as control variables in the multivariate models. In some ways, I-BEST students appear to be relatively similar to Non-I-BEST students. There are, however, differences worth noting. All basic skills students, whether or not they enrolled in I-BEST, were enrolled in either ESL or ABE, with the latter possibly including a GED component. Table 4 shows that ABE/GED enrollment was dominant among I-BEST students. More than two thirds of I-BEST students were enrolled in ABE (or GED) instruction, compared to 36 percent of Non-I-BEST students. These proportions are reversed when comparing students in the groups

who enrolled in ESL (31 percent of I-BEST versus 64 percent of Non-I-BEST students, respectively, were enrolled in ESL). Other differences of note are the percentage of students receiving financial aid and the percentage enrolled full time. In both cases, I-BEST students held an advantage in that they were more likely to receive aid and enroll full time. In terms of race/ethnicity, I-BEST students were much less likely than Non-I-BEST students to be Hispanic and much more likely to be Black.

There are also noteworthy similarities and differences between I-BEST students and the Non-IB Workforce student subset. Both the I-BEST and the Non-IB Workforce students were mainly ABE/GED students, as opposed to the Non-I-BEST students as a whole, who were predominantly ESL students. Non-IB Workforce students were also more likely than others to indicate upon entry that they intended to earn an academic credential or transfer to a four-year institution. Twenty percent of Non-IB Workforce students indicated this, compared to 7 percent of I-BEST students and 9 percent of all Non-I-BEST students.

Table 4. Characteristics of Basic Skills Students, 2006-07

	I-BEST	All Non-I-BEST	Non-IB Workforce
Number of students in program	896	30,182	1,356
Program classification			
I-BEST student	100%	0.0%	0.0%
ABE/GED student	69.0%	36.0%	66.4%
ESL student	30.9%	63.8%	33.3%
Non-IB Workforce student	0.0%	4.5%	100.0%
Social and economic characteristics			
Mean age	32.5	32.3	31.9
Female	64.8%	60.5%	69.2%
Hispanic	18.4%	38.3%	21.3%
Black, non-Hispanic	12.1%	6.9%	6.1%
Asian/Pacific Islander	12.3%	15.0%	12.4%
Single w/ dependent	22.2%	14.0%	22.8%
Married w/ dependent	27.8%	26.5%	24.1%
Disabled	7.1%	3.8%	11.0%
Estimated socioeconomic status[4]	3.6	3.5	3.5
Current schooling characteristics			
Intent is vocational[5]	72.4%	22.7%	48.4%
Intent is academic	7.4%	9.1%	20.0%
Received aid	25.9%	2.1%	14.2%
Enrolled full time	67.1%	32.6%	49.0%
First enrolled in 1st quarter	30.1%	27.5%	40.0%
First enrolled in 2nd quarter	41.0%	33.1%	40.2%
First enrolled in 3rd quarter	18.5%	22.5%	15.6%
First enrolled in 4th quarter	10.4%	16.9%	4.2%
Previous schooling characteristics			
Mean college credits	13.9	0.9	8.8
Mean vocational credits	9.1	0.6	5.8
GED	12.7%	4.0%	10.0%
High school graduate	27.3%	16.9%	25.7%
Some college	10.4%	4.1%	7.5%
Certificate	3.7%	1.7%	3.4%
Associate degree	2.5%	1.8%	2.2%
Bachelor's degree	4.0%	4.6%	5.1%

[4] This is based on the quintile of the average socioeconomic status of the Census block group in which the student's residence is found. 1 is the highest quintile, and 5 is the lowest. For details, see Crosta, Leinbach, Jenkins, Prince, and Whitakker (2006) and WSBCTC (2006).

[5] Vocational and academic intent indicate the type of college program the student means to pursue. If vocational, the student intends to pursue workforce training; if academic, the student intends to pursue a program that leads to a degree and/or transfer to a four-year institution. Students do not always follow their stated intent (see Bailey, Jenkins, & Leinbach, 2006).

3.2 Estimates of the probability of earning college credit

Table 5 shows regression estimates of the differences in the probability of earning college credit (including college vocational credit[6]) relative to the Non-IB Non-Workforce baseline group — those basic skills students who took neither I-BEST nor any other workforce course. As shown in Table 5, even after controlling for demographic characteristics, enrollment intent and intensity, and previous schooling, I-BEST students' probability of earning college credit was 81 percentage points higher than that of the Non-IB Non-Workforce students. There are no significant differences between the estimates for I-BEST students who started in ABE/GED and those who started in ESL. Both groups appear to have benefited similarly by enrolling in I-BEST.

Table 5 also shows that Non-IB Workforce students (basic skills students who took at least one workforce course but did not participate in I-BEST) also did better than Non-IB Non-Workforce students — the former had a probability of earning college credit that was 47 percentage points higher than the latter. However, the probability that Non-IB Workforce students earned college credit was still not as high as that for I-BEST students. Using the regression results and holding the values of all explanatory variables other than those corresponding to the three groups of interest at their means, we estimated that the probability of earning college credit was 84 percent for I-BEST students, compared to 50 percent for Non-IB Workforce students and only 3 percent for Non-IB-Non-Workforce students (results not shown in the table).

Table 6 shows the propensity score matching estimates of the differences in the probability of earning college credit between the I-BEST students and both the unmatched basic skills population and the matched comparison group. By this PSM method, we estimate that the average difference in probability of earning college credit between I-BEST students and students in the comparison group was 23 percentage points. The mean probability for I-BEST students was 90 percent; it was 67 percent for the comparison group (results not shown in the table).

As mentioned, we cannot statistically compare the results of the regressions with those of the PSM analysis because each takes a different approach to selecting

[6] Throughout this paper, the findings we report concerning college credits always include college vocational credits.

appropriate comparison groups. However, the fact that these two different methods yield effect size estimates that are similar in magnitude increases our confidence in the results. As noted in the appendix, we believe that PSM may give a more accurate estimate of the program's effect on a given outcome.

Table 5. Logistic Regression Estimates of Differences in the Probability of Earning College Credit Relative to Non-IB Non-Workforce Students, 2006-08

	Overall	ABE/GED	ESL
I-BEST Students	0.81***	0.78***	0.83***
	(0.02)	(0.03)	(0.04)
Non-IB Workforce Students	0.47***	0.54***	0.40**
	(0.02)	(0.02)	(0.04)
Pseudo R^2	0.440	0.431	0.427
Observations	27,426	10,058	17,288

Note: * p<0.10, ** p<0.05, *** p<0.01

Effect shown for discrete change of variable from 0 to 1.

Table 6. PSM Estimates of Differences in the Probability of Earning College Credit Relative to Unmatched and Matched Non-I-BEST Students, 2006-08

	Unmatched	Average treatment effect on the treated (ATT)
I-BEST Students	0.83***	0.23***
	(0.01)	(0.03)

Note: * p<0.10, ** p<0.05, *** p<0.01

3.3 Estimates of the number of credits earned

Table 7 reports the results from estimating differences in the number of college and college vocational credits earned by I-BEST and Non-IB Workforce students compared to Non-IB Non-Workforce students. Once again using regressions to control for the factors indicated in Table 4, the left side of Table 7 shows that I-BEST students earned, on average, an estimated 44 more college credits — equivalent to approximately one full academic year[7] — than Non-IB Non-Workforce students, and 14 more college credits than Non-IB Workforce students. Using the regression results, we estimated that I-BEST students earned an average of 45 college credits compared to 31 for the Non-IB Workforce students and 1 credit for the Non-IB Non-Workforce group (results not shown in table).

ABE/GED students in I-BEST earned 50 more college credits, and ESL students in I-BEST earned 35 more college credits than Non-IB Non-Workforce students. These estimates are 19 and 8 credits more than those earned by Non-IB Workforce students who were enrolled in ABE/GED and ESL, respectively.

The three columns on the right side of Table 7 show the results for college vocational credits. Even after controlling for demographic characteristics and other factors, I-BEST students — overall and by ABE/GED and ESL subgroup — earned more vocational credits than Non-IB Non-Workforce students and Non-IB Workforce students. I-BEST students earned, on average, an estimated 40 more college vocational credits than Non-IB Non-Workforce students and 18 more than Non-IB Workforce students. We estimated that, on average, I-BEST students earned 40 vocational credits, Non-IB Workforce students earned 22 and Non-IB Non-Workforce students earned less than one.

ABE/GED I-BEST students earned 45 more college vocational credits than Non-IB Non-Workforce students and 21 more than the Non-IB Workforce group. ESL I-BEST students earned 31 more college vocational credits than Non-IB Non-Workforce students and 14 more than Non-IB Workforce students.

Table 8 shows the PSM estimate of the difference in the number of credits earned by I-BEST students compared with Non-I-BEST students to whom they were matched based on similar background characteristics and prior enrollment patterns. The mean

[7] The Washington State community and technical colleges operate on a quarter system.

number of credits earned by I-BEST students was 52, compared to an average of 34 for the matched comparison group — a difference of 18 credits. I-BEST students earned an average of 45 vocational credits, while the matched comparison group earned an average of 24 vocational credits, a difference of 21 vocational credits. (Only results on the differences in credits earned are shown in the table.) Though not directly comparable, the regression and PSM estimates are of similar magnitude, indicating that the results are robust.

Table 7. OLS Regression Estimates of Differences in the Number of Total College and College Vocational Credits Earned Relative to Non-IB Non-Workforce Students, 2006-08

	College credits			Vocational credits		
	Overall	ABE/GED	ESL	Overall	ABE/GED	ESL
I-BEST Students	44.35***	49.74***	34.81***	39.64***	44.58***	30.97***
	(1.62)	(2.23)	(2.15)	(1.48)	(2.03)	(1.95)
Non-IB Workforce Students	30.36***	31.11***	26.96***	21.52***	23.06***	17.31***
	(1.28)	(1.57)	(2.16)	(1.04)	(1.32)	(1.58)
R-squared	0.434	0.455	0.385	0.411	0.427	0.375
Observations	27,426	10,058	17,297	27,426	10,058	17,297

Note: * p<0.10, ** p<0.05, *** p<0.01

Table 8. PSM Estimates of Differences in the Number of Total College and College Vocational Credits Earned Relative to Matched and Unmatched Non-I-BEST Students, 2006-08

	College credits		Vocational credits	
	Unmatched	Average treatment effect on the treated (ATT)	Unmatched	Average treatment effect on the treated (ATT)
I-BEST Students	49.60***	18.48***	43.18***	21.39***
	(0.56)	(2.71)	(0.45)	(2.26)

Note: * p<0.10, ** p<0.05, *** p<0.01

3.4 Estimates of the probability of persisting into 2007-08

We measured persistence into the second academic year, 2007-08, by examining whether a student had any transcript record in that year. By this definition, in order to have persisted, students must have completed, though not necessarily passed, a course in that year. We also considered students as having persisted if they earned an award in 2006-07, even if they did not persist into 2007-08, because these students experienced a successful outcome. The results of the logistic regressions and PSM models for this outcome are shown in Tables 9 and 10.

Using a logistic regression model, we estimated that, on average, I-BEST students had a probability of persisting that was 42 percentage points higher than Non-IB Non-Workforce students. Among those enrolled in ABE/GED in both these groups, I-BEST students had a probability that was 47 percentage points higher. The corresponding difference in chances for ESL students was 41 percentage points. A regression that compared I-BEST students with Non-IB Workforce students found that the former had a probability of persisting that was 13 percentage points higher, with an error of 2 percentage points.

Comparing Non-IB Workforce students to Non-IB Non-Workforce students, we found that the former had a probability of persisting that was 30 percentage points higher the latter. The corresponding probability differences for the ABE/GED and ESL subgroups of each of these groups were 35 and 26 percentage points, respectively.

Using the regression results and holding the value of all variables other than the dummy variables corresponding to the three groups of interest at their means, we estimated that I-BEST students had an 80 percent probability of persisting into the second year (or completing a credential), compared to 68 percent for the Non-IB Workforce students and 38 percent for the Non-IB Non-Workforce group (results not shown in the table)

As shown in Table 10, our PSM model of persistence found that I-BEST students had a probability of persisting that was 17 percentage points higher than matched students. The I-BEST students had a 78 percent probability of persisting, compared to 61 percent for the matched students (not shown in the table). Here again, the results of the PSM model are similar to those of the regressions.

Table 9. Logistic Regression Estimates of Differences in the Probability of Persisting into 2007-08 Relative to Non-IB Non-Workforce Students

	Overall	ABE/GED	ESL
I-BEST Students	0.42***	0.47***	0.41***
	(0.02)	(0.02)	(0.03)
Non-IB Workforce Students	0.30***	0.35***	0.26***
	(0.02)	(0.02)	(0.03)
Pseudo R^2	0.058	0.096	0.046
Observations	27,426	10,058	17,297

Note: * p<0.10, ** p<0.05, *** p<0.01

Effect shown for discrete change of variable from 0 to 1.

Table 10. PSM Estimates of Differences in the Probability of Persisting into 2007-08 Relative to Matched and Unmatched Non-I-BEST Students

	Unmatched	Average Treatment Effect on the Treated (ATT)
I-BEST Students	0.39***	0.17
	(0.02)	(0.05)

Note: * p<0.10, ** p<0.05, *** p<0.01

3.5 Estimates of the probability of earning an award

Table 11 shows the results of the regression estimates of the differences in the probability of earning an award by I-BEST and Non-IB Workforce students relative to the baseline group, Non-IB Non-Workforce students. Awards may have been earned at any time within the two academic years of 2006-07 and 2007-08, and include occupational certificates and associate degrees granted by the system. As was shown in Table 3, however, virtually all of the awards earned by the students under study here were certificates.

Controlling for student characteristics and prior enrollment patterns, I-BEST students had a probability of earning an award that was 51 percentage points higher than that of Non-IB Non-Workforce students. Non-IB Workforce students had a probability of doing so that was 16 percentage points higher than Non-IB Non-Workforce students. ABE/GED I-BEST students had a probability of earning an award that was 42 percentage points higher than ABE/GED Non-IB Non-Workforce students. For the ABE/GED Non-IB Workforce group, the corresponding difference is 13 percentage points. For I-BEST and Non-IB Workforce students enrolled in ESL, the respective differences are 57 percentage points and 10 percentage points. An additional regression model, not shown in the tables, found that I-BEST students had a probability of earning an award that was 35 percentage points higher than that of Non-IB Workforce students, with an error of 4 percentage points.

Based on the regression results, we estimated that I-BEST students had a 51 percent probability of earning an award, compared to 16 percent for the Non-IB Workforce students and effectively zero percent for the Non-IB Non-Workforce group (results not shown in the table).

Table 12 shows the PSM model estimate of the increased probability of earning an award by I-BEST students compared to matched Non-I-BEST students. Based on this model, we found that I-BEST students had a 55 percent probability of earning an award, compared to only 15 percent for the matched group (these results are not shown in the table) — a 40 percentage point difference. The fact that the PSM estimates are similar to those from the regression analysis is reassuring. As mentioned, there are reasons to believe that the PSM estimates are more accurate than those of the regression.

Table 11. Logistic Regression Estimates of Differences in the Probability of Earning an Award Relative to Non-IB Non-Workforce Students, 2006-08

	Overall	ABE/GED	ESL
I-BEST Students	0.51***	0.42***	0.57***
	(0.03)	(0.04)	(0.06)
Non-IB Workforce Students	0.16***	0.13***	0.10***
	(0.02)	(0.02)	(0.03)
Pseudo R^2	0.672	0.621	0.759
Observations	25,473	9,541	14,535

Note: * p<0.10, ** p<0.05, *** p<0.01

Effect shown for discrete change of variable from 0 to 1.

Table 12. PSM Estimates of Differences in the Probability of Earning an Award Relative to Matched and Unmatched Non-I-BEST Students, 2006-08

	Unmatched	Average treatment effect on the treated (ATT)
I-BEST Students	0.55***	0.40***
	(0.00)	(0.02)

Note: * p<0.10, ** p<0.05, *** p<0.01

3.6 Estimates of the probability of achieving point gains on basic skills tests

Table 13 shows the results of estimates of the increased probability that I-BEST and Non-IB Workforce students made any point gains in basic skills testing compared to Non-IB Non-Workforce students. To make point gains, students needed to show a gain on any of the Comprehensive Adult Student Assessment Systems (CASAS)[8] tests, whether in reading, listening, or math.

The results of logistic regressions indicate that, on average, I-BEST students had a probability of making CASAS point gains that was 18 percentage points higher than Non-IB Non-Workforce students. Non-IB Workforce students had a likelihood of making such gains that was 5 percentage points higher than the Non-IB Non-Workforce group. ABE/GED I-BEST students had, on average, a probability that was 21 percentage points higher than ABE/GED Non-IB Non-Workforce students. For the ABE/GED Non-IB Workforce group, the corresponding difference was 9 percentage points. For I-BEST and Non-IB Workforce students enrolled in ESL, the respective differences were 20 percentage points and 6 percentage points. Regression analysis (not shown in the table) indicates that I-BEST students had a probability that was 13 percentage points higher than Non-IB Workforce students, with an error of 2 percentage points on the estimate.

Based on the regression results, we estimated that the probability of achieving a CASAS test score gain was 60 percent for I-BEST students, compared with 47 percent for Non-IB Workforce students and 43 percent for Non-IB Non-Workforce students (estimates not shown in the tables).

Table 14 shows the PSM model estimates. The I-BEST students had a 62 percent likelihood of achieving a basic skills point gain, compared to a 45 percent probability for the matched Non-I-BEST students (these are not shown in the table), a difference of 17 percentage points. Once again, the similarity between the PSM and regression estimates increases the robustness of the findings.

[8] See http://www.casas.org for more information on these tests.

Table 13. Logistic Regression Estimates of Differences in the Probability of Achieving Basic Skills Point Gain Relative to Non-IB Non-Workforce Students, 2006-08

	Overall	ABE/GED	ESL
I-BEST Students	0.18***	0.21***	0.20***
	(0.02)	(0.03)	(0.03)
Non-IB Workforce Students	0.05**	0.09***	0.06*
	(0.02)	(0.02)	(0.03)
Pseudo R^2	0.047	0.043	0.052
Observations	27,398	10,050	17,297

Note: * p<0.10, ** p<0.05, *** p<0.01

Effect shown for discrete change of variable from 0 to 1.

Table 14. PSM Estimates of Differences in the Probability of Achieving a Basic Skills Point Gain Relative to Matched and Unmatched Non-I-BEST Students, 2006-08

	Unmatched	Average treatment effect on the treated (ATT)
I-BEST Students	0.18***	0.17***
	(0.02)	(0.04)

Note: * p<0.10, ** p<0.05, *** p<0.01

4. Conclusion

Our findings indicate that students participating in I-BEST achieved better educational outcomes than did other basic skills students who did not participate in the program. I-BEST students were more likely to continue into credit-bearing coursework and to earn credits that count toward a college credential. They were more likely to persist into the second year, to earn educational awards, and to show point gains in basic skills testing. On all outcomes, I-BEST students did moderately or substantially better than basic skills students who did not enroll in any workforce course. Moreover, I-BEST students had better outcomes than those basic skills students who enrolled in at least one workforce course in the same academic year. While the I-BEST group's comparative advantage relative to this latter group was not as large, it was still significant. The apparent educational benefits were reaped by I-BEST students who started in either ABE/GED or ESL.

These results are robust with respect to two methodologies: regression (linear or logistic) and propensity score matching (PSM). Both methodologies control for observed differences between the treated (I-BEST) and comparison groups, but neither can control for selection bias that may be due to unobserved differences between the groups. Some of these unobserved differences are likely to be related to the selection process, which we only partially understand. Thus, while the results show that participation in I-BEST is *correlated* with better educational outcomes over the two-year tracking period, it is important to note that they do not provide definitive evidence that the I-BEST program *caused* the superior outcomes. It could be that, because of the way students are selected into the program, those who participate have higher motivation or other characteristics not measured in this study that make them more likely to succeed. CCRC plans to conduct further research to better understand the process by which students are selected into I-BEST. We will explore the feasibility of using quasi-experimental methods to remedy possible selection bias. The strong positive nature of our findings suggests that an experimental test of I-BEST, in which students are randomly assigned to a treatment or a control group, might be warranted.

As we are able to follow I-BEST students over time and collect more information about them, we plan to study their degree attainment and labor force outcomes, such as employment rates and earnings. CCRC also plans to extend the study to those students who enrolled in an I-BEST program in academic year 2007-08, when the program was expanded to include all the institutions in the Washington State community and technical college system. We will use data on these students to identify I-BEST programs that have superior educational and labor market outcomes, controlling for student characteristics, and will conduct field research to identify the practices of effective programs. Finally, we will also collect data on program finances to estimate the cost-benefit of the I-BEST approach and thus help to assess the feasibility of offering it on a wide scale.

Appendix: A Brief Description of Propensity Score Matching

Propensity score matching (PSM) matches "treated" subjects — in this case, students served by I-BEST programs — to selected untreated "control" subjects — in this case, basic skills students who did not enroll in I-BEST — who have similar background characteristics (Rosenbaum & Rubin, 1983; Winship & Morgan, 1999). PSM conducts comparisons between similar pairs of students who differ on whether or not they received the treatment, but have similar other observed characteristics.

PSM first estimates the "propensity score," which is an assessment of the propensity to be treated. It does this by performing a logit or probit regression of the treatment dummy variable on all available covariates that, in the researcher's judgment, have the potential to influence the chances of being treated. Treated and untreated observations are then matched based on having similar propensity scores, and then the average treatment effect on the treated (ATT) can be estimated, which is the average difference on an outcome of interest between the matched treated and untreated observations.[9] The ATT is the average effect of the treatment on the sort of person who participates in the program. The effectiveness of PSM is, in part, a function of having enough relevant information about the cases to accurately estimate the propensity score, and thus accurately estimate the ATT using the matching process that uses this score.

The matching process selects from those observations for which there is "common support," that is, whose distribution of propensity scores are deemed by the algorithm to be sufficiently close to the propensity scores of the treated observations. The fact that PSM draws its comparison group from the observations that give common support, rather than all observations as is typically done when regression is employed, is one reason why PSM estimates may be more accurate.

In addition, unlike regression, PSM does not assume a particular functional relationship between an outcome of interest and the available relevant covariates, including treatment status. In contrast, if we estimated a linear regression model of an outcome, such as college credits earned, on a treatment status dummy variable (here I-

[9] There are many variants of PSM, many of which match each treated observation to a weighted set of matched untreated observations, rather than a single observation. Herein, we have used probit to estimate the propensity score and a local linear regression estimator, which is one method of conducting such a match (Todd, 1999).

BEST participation) and a number of controls, such as demographics, etc., we would obtain an estimate of a fixed effect of treatment across all of the cases (assuming that we did not interact the treatment status dummy variable with any other covariates). PSM does not do this; the treatment effect varies with each matched pair of treated and untreated cases, and is the difference in the outcome between the two cases.

References

Bailey, T. R., Jenkins, D., Leinbach, D. T. (2006, September). *Is student success labeled institutional failure? Student goals and graduation rates in the accountability debate at community colleges.* CCRC Working Paper No.1. New York: Columbia University, Teachers College, Community College Research Center. Available at http://ccrc.tc.columbia.edu/Publication.asp?uid=342

Barton, P. (2000). *What jobs require: Literacy, education, and training, 1940–2006.* Princeton, NJ: Educational Testing Service. Retrieved from http://www.ets.org/Media/Research/pdf/PICJOBS.pdf

Baum, S., & Ma, J. (2007). *Education pays 2007: The benefits of higher education for individuals and society.* New York: College Entrance Examination Board. Retrieved from http://www.collegeboard.com/prod_downloads/about/news_info/trends/ed_pays_2007.pdf

Bloomer, T. (2008, October). Education + work skills = jobs. *Literacy Update*. New York: Literacy Assistance Center. Retrieved from http://www.lacnyc.org/resources/publications/update/Update2008-9/Oct08Rev.pdf

Crosta, P., Leinbach, T., Jenkins, D., Prince, D., & Whitakker, D. (2006, July). *Using census data to classify community college students by socioeconomic status and community characteristics.* CCRC Research Tools No. 1. New York: Columbia University, Teachers College, Community College Research Center. Available at http://ccrc.tc.columbia.edu/Publication.asp?uid=430

Osterman, P. (2008, August). *College for all? The labor market for college-educated workers.* Washington, DC: Center for American Progress.

Prince, D., & Jenkins, D. (2005). *Building pathways to success for low-skill adult students: Lessons for community college policy and practice from a statewide longitudinal tracking study.* CCRC Research Brief No. 25. New York: Columbia University, Teachers College, Community College Research Center. Available at http://ccrc.tc.columbia.edu/Publication.asp?UID=288

Resnick, L. B. (1987). The 1987 presidential address: Learning in school and out. *Educational Researcher*, *16*(9), 13-20, 54.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70,* 41-55.

Shore, M., Shore, J., & Boggs, S. (2004). Allied health applications integrated into developmental mathematics using problem based learning. *Mathematics and Computer Education*, *38*(2), 183-189.

Sticht, T. G. (1997). The theory behind content-based instruction. *Focus on Basics*, *1*(D), 6-10. Retrieved from http://www.iu13.org/ipq/content_based.pdf

Stone, J. R., Alfred, C., Pearson, D., Lewis, M. V., & Jensen, S. (2005). *Building academic skills in context: Testing the value of enhanced math learning in CTE, pilot study*. Columbus, OH: National Research Center for Career and Technical Education. Retrieved from ERIC database.

Todd, P. E. (1999). *A practical guide to implementing matching estimators.* Philadelphia: University of Pennsylvania Department of Economics. Retrieved from http://athena.sas.upenn.edu/~petra/papers/prac.pdf

U.S. Census Bureau. (2007a). *Educational attainment* (American Fact Finder, Table S1501). Retrieved from U.S. Census Bureau: http://tinyurl.com/9bao99

U.S. Census Bureau. (2007b). *Language spoken at home* (American Fact Finder, Table S1601). Retrieved from U.S. Census Bureau: http://tinyurl.com/cas8nh

U.S. Department of Education. (2006). *State-administered adult education program: Program year 2004-2005 enrollment.* Washington, DC: Office of Vocational and Adult Education, Division of Adult Education and Literacy. Retrieved from http://www.ed.gov/about/offices/list/ovae/pi/AdultEd/aedatatables.html

WSBCTC [Washington State Board for Community and Technical Colleges]. (2005). *I-BEST: A program integrating adult basic education and workforce training.* Olympia, WA: Author. Retrieved from http://www.sbctc.ctc.edu/college/d_basicskills.aspx

WSBCTC. (2006). *The socioeconomic well-being of Washington State: Who attends community and technical college*. Olympia, WA: Author. Retrieved from http://www.sbctc.ctc.edu/docs/data/research_reports/resh_06-4_socioeconstudy.pdf

WSBCTC. (2008). *Increasing student achievement for basic skills students* (Research Report No. 08-1). Olympia, WA: Author. Retrieved from http://www.sbctc.ctc.edu/college/education/resh_rpt_08_1_student_achieve_basic_skills.pdf

Weinbaum, A., & Rogers, A. M. (1995). *Contextual learning: A critical aspect of school-to-work transition programs*. Washington, DC: National Institute for Work and Learning. Retrieved from http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/13/d5/a1.pdf

Winship, C., & Morgan, S. L. (1999). The estimation of causal effects from observational data. *Annual Review of Sociology*, *25*, 659-707.